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Digital Cultural Heritage

By Trilce Navarrete

Introduction

What is the impact of media technology on the supply and demand of heritage with what is usually described as *digitization*? this chapter presents the concept of digitization as concerning far more than just the introduction of computers, the development of databases and websites, and the conversion of information to digital form. digitization – the process of *adapting* to developments in media technology – implies far more than just *adopting* technology. What is argued here, is that digitization produces three fundamental changes with respect to the supply and demand of heritage content. firstly, technology has prompted the creation of a digital heritage product. digitization has resulted in a process to formalize heritage knowledge as an exchangeable good. secondly, the consumer has gained a certain independence to acquire digital content, no longer linked to the producer's physical location. thirdly, adoption of digital technology in all segments of life have led to a change in consumer expectations, with a demand for digital heritage content at the right place and time, and even an option to participate in the production process.

What started as a mechanical process to reduce repetition of data entry and to facilitate data query for heritage content providers has come to represent an important step towards universal access to human heritage. the possibility of accessing digital heritage (as information content) has advanced an international awareness of heritage and furthered efforts to promote knowledge of and access to it. this awareness is reflected in the work of the European commission culminating in recommendations on the digitization and online accessibility of cultural material and digital preservation from 2006.¹ meanwhile, UNESCO has taken a more pragmatic approach by advocating for (digital) documentation of collections as preventive conservation and to combat illicit traffic.²

This chapter presents an overview of the changes in supply and demand of cultural heritage goods and services as influenced by digital technology. to start with, digital cultural heritage content will be defined, as it will be discussed in this chapter. an examination of issues related to the supply and demand of digital cultural heritage brought by digitization will follow.

Digitization: some definitional issues

In the strict sense of the word, digitization refers to making content digital. it represents the translation of information using a data technology of discrete values (e.g. braille, DNA, abacus) to transfer content. digitization of cultural heritage refers to making heritage objects and services digital.

Heritage objects housed at libraries, museums, archives or archaeology sites, share the same characteristics:³ collections include ‘objects’ (tangible and intangible;⁴ movable and immovable) and their documentation, made up of some form of representation (or visualization) and some form of description (or contextualization). digitization of heritage objects includes both the ‘object’ as well as its documentation.

Once heritage objects are made digital, three types of digital heritage goods can be identified: *digitized* goods, *born-digital* goods and *meta- data* (den, 2008). digitized goods refer to content generated as a copy of a physical original, such as a digital image of a painting or a scan of an archival document. this process is usually referred to as *digitization*. content can also be generated in digital form, hence being *born digital*, as in the case of digital (video) art.

Objects are identified by documented descriptive information (such as size, date, origin and title) and by a representation (which can be a drawing, a photograph or a written description). in addition, heritage institutions have realized that objects require a context in order to be understood and valued. generating this context, or object *metadata*, is actually a digitization of information resulting either from an earlier form of documentation (e.g. paper archive, object registration cards) or from information in ‘people’s heads’ (e.g. personal knowledge; Navarrete, 2009). metadata serves to identify, describe, control and exploit objects (Baca et al., 2008:119). it includes descriptions, explanations, and administrative information (Baca et al., 2008; DEN, 2008).

Digital data can evolve during the preservation process (e.g. as the file is updated to a newer software version during migration⁵) or as new information becomes available about the object (e.g. as ownership of the object changes hands). documenting the change in collection information by adding new records while keeping the previous ones is sometimes referred to as *paradata* but more frequently it is included within the scope of *metadata*.

There is a subtle, though fundamental, difference observed in the nature of heritage as it is translated into digital format. there is content that can be expressed either on a physical or in a digital format without significant difference (such as articles published either on paper or digital journals). In this case the digital format represents a form of *conversion*. Conversely digitization represents a *surrogacy*⁶ for objects that change significance, meaning or

cultural value when translated into digital format (as is the case of digital representations of architectural projects) (Poole, 2010).

Intangible heritage becomes tangible when digitized. that is, the translation to digital format represents a form of documentation when, for instance, oral history (intangible form) is digitally recorded (tangible form) (Navarrete, 2009). institutional annual reports, on the other hand, report recordings of music and dance as 'intangible heritage objects' (Beumer, 2009).

Heritage institutions collecting, researching, preserving and presenting heritage collections also produce intangible goods, or services. these services can also be translated into a digital environment. examples include an on-site guided tour provided by a member of staff or available in digital form (conversion), or an on-site exhibit translated online (surrogate). digital services produced are related to, and limited by, the digital goods available. that is, a library can only make e-books available online (digital service) after acquiring such e-books (digital good). it is important to note that goods and services produced can be consumed in mixed environment (physical and digital). the increasing availability of digital heritage goods and services is accompanied by a fluidity of consumption (on-site and online).

Effects of digitization on cultural heritage supply

Supply of digital cultural heritage can increase or decrease in reaction to a number of determinants. changes in the cost of production will of course have an impact with more digital images being made when the reproducibility cost per additional image is close to zero. other factors influencing supply include the reason for production, the expectation on demand, the expectation of future price changes, joint supply of products, and total number of suppliers. interestingly, digitization has allowed for new forms of cultural heritage representation, resulted in an increased supply and greater diversity of products and of their use, and the development of new cultural heritage experiences. because of digitization, heritage institutions now supply a product, an exchangeable good, next to the services, which used to characterize their supply.

Changes in Supply Brought by Changes in Production

Heritage institutions have experimented with the use of computers since the late 1960s mostly for the management of information about collections.

It was much more convenient for libraries to exchange books, coordinate acquisition policy and organize their collections using a digital catalogue system. museums could unify collection management information in one digital system facilitating object management, coordinating acquisitions, exhibitions and loans.⁷ similarly, archives adopted digital document management systems to improve location of collections at series, file or document level.⁸ in the

archaeology field, digital techniques were first adopted to facilitate fieldwork (i.e. measurements during excavations) and later for collection management. that is, the raw data gathered from scientific research became an important part of the digital archeological collection that required a digital management work process.⁹ in all cases, production of digital content was meant for internal consumption, thus by the producing heritage institutions and to improve overall output. Heritage institutions, therefore, supplied digital content with a particular interface and specialized vocabulary. as digitized products derived into an expanded consumption to society at large, supply to outside consumers has required a new user interface, different features and a different vocabulary.

The relative reduction in the cost of technology has led to an increase in supply of digital cultural heritage. even though there is a high sunk cost, i.e. the cost of adopting a digital technology, computers have evolved to become an accessible technology. in 1987, only 4 per cent of the 800 Dutch museums could afford to acquire a computer, train staff and supply digital heritage content. by 2007, the average Dutch museum reported having 15 computers and five printers.¹⁰

Up-front sunk costs with long-term experienced benefits have resulted in a careful adoption of digital technologies by heritage institutions. costs include the acquisition of hardware and software, migration and integration of content, system maintenance, in addition to initial and ongoing staff training, support from system providers, costs related to hosting, overall management costs, deaccessioning and project planning. sunk costs are linked to lock-in cost, the choice of the technology adopted.¹¹

Labour has been estimated to represent more than half of the digitization related costs (69 per cent in archives and libraries and 98 per cent in museums) (den, 2009). this is because much of the work is still done manually. institutions can increase supply by lowering costs of production related to labour by letting computers do the work. for example, computers can partially identify and contextualize content. for other activities, however, such as object selection, this is not possible. selecting the objects to digitize is commonly guided by identifying the top pieces and the unique objects, followed by the most popular, simple to scan, sizeable units, or objects that can represent the rest of the collection. selection is a labour-intensive activity.

Digitization has brought a reorganization of the production process. the *life cycle of digital content* identifies the labour activities in the production of digital cultural heritage: (1) preparation of objects for acquisition, generally preparation of physical materials to be digitized,¹² (2) acquisition and collection development, or scanning,¹³ (3) identification of digitized material and cataloguing,¹⁴ (4) storage, (5) access, including retrieval and harvesting, (6) presentation, (7) management and use, including rights management and security,¹⁵ (8) interoperability,¹⁶ and (9) preservation.¹⁷ Preservation strategies involve migration and emulation. asset sustain- ability is dependent on other

activities.¹⁸ establishing ownership of digital content during production is fundamental to ensure long-term access.

Stages in the life cycle of digitization are interrelated and decisions in one stage have cost consequences for later stages (e.g. lock-in costs).¹⁹ ensuring best practice during production can represent lower future clean-up costs thus higher supply of digital cultural heritage.

As the life cycle of digital content has shown, the process from adopting a computer to being able to supply digital heritage content to the consumer is long and labour intensive. for that reason, heritage organizations that opted for an information management system for the registration of collections may be reluctant to change the system unless a significant subsidy is provided for that end. the adoption of information technology requires a change in the organizational work practice. this change has generally signified an increase in the supply of digital heritage content.

Supply can increase as a consequence of reduced costs of production linked to the process and technology selected per type of object digitized. each cultural heritage form can be matched by a technique that best serves use as well as representation.²⁰

As result of institutional work practice, standard choices for digital representations of cultural heritage are emerging. Heritage institutions can then increase supply by best adapting their work practice to available inputs.

Once the initial investment has been made to produce a digital heritage product it can be made available in different versions for different market segments.²¹ this is called versioning. Versioning can be done at little additional cost when the technical infrastructure is available. Versioning of digital heritage allows for price discrimination. institutions offering digitization on demand (as in the case of the Amsterdam city archive) charge a higher price for higher image resolution, charge for access from home (by law, information must be made available for free at the city archive), and charge a rush fee for processing requests in less than 2 weeks (Holtman, 2006). audiovisual collections (such as those of the Dutch institute of sound and image) can be made available as short clips free of charge, as screen shot (for identification), as full programs for private consumption, or as materials for further broadcasting (with a €500.00 licensing cost).

The multiplicity of versions and copies of content possible through digitization has been limited by issues of intellectual property rights exacerbated by the increased number of content producers involved. clearing copyright for the publication of a catalogue is different than when considering digital publication on a museum's website, for the blog, via iPhone application, and so on. alternative forms of copyright clearance are being explored via creative commons.²²

Supply of digital heritage can broadly be grouped in 3 categories: (1) online brochures (basic information about the producing institution, e.g. opening times and address); (2) digital content (information about the collections with images and text); and (3) interactive service (allowing participation, interaction and contribution). supply of content by the consumer (contribution) can be referred to as user-generated content representing a shift in the roles of the production process. in such case, content is provided 'for free'. this is also referred to as *crowdsourcing*. the role of the responsible institution becomes that of coordinator of the consumer's input. Production costs may be reduced and resources instead be directed towards other activities.²³ in other words, heritage institutions supply 'finished' products as well as 'intermediate' products that transform into finished products with further (consumer) input. supply of heritage content thus increases with consumer input.

In short, digitization allows an increase in production of cultural heritage by changing the production process to one that is digitally adapted to best match available inputs. Production has changed by reorganizing the roles (producers, consumers), activities (manual, automated, outsourced) and technology used (digital) by heritage institutions to supply cultural heritage content (in finished and unfinished form). digitization has further led to new products being explored to best represent cultural heritage digitally (text, image, sound, moving image, locative or spatial). Wider access to digital technology has also facilitated the reproduction and versioning of content thereby increasing supply of digital heritage content. However, the digitization process still relies on intensive labour and this represents a high cost which has not yet been substituted by machines and consequently limits supply growth.

Change in Supply Brought by Joint Supply of Products

Producing digital cultural heritage involves more than publishing images or a catalogue online. collections are better understood when placed

Within a historic and contextual setting. that is, production of digital cultural heritage must include the representation (e.g. image) and documentation (e.g. metadata) of the object. because of this, an increase in the supply of reproductions must be accompanied by an increase in metadata production. this is still not always the case because, as mentioned above, production of metadata is labour intensive (at least much higher in comparison to the production of representations). Perhaps the participation of consumers in the supply of metadata can bring this joint supply of products, representation and documentation, into equilibrium.

Digitization facilitates versioning and reproduction, making distribution of content possible through multiple channels. institutions can distribute digital content on-site using local networked systems (e.g. computer terminals), online (e.g. through the World Wide Web), via alternative distribution forms (i.e. via the consumers' smartphone), or mixed in the physical environment in any

number of ways. most commonly, on-site (physical) visits can be enhanced with additional information provided either through computer terminals or as content superimposed to a site or object using the 'old fashioned' image projectors or through augmented reality (AR) enabling technologies.²⁴ mixed realities, or the cyber-real space interplay, as well as other simulators (e.g. interactive flight simulator) have been used for education and modelling of objects and situations and experiences not readily available. once cultural heritage has been digitized, multiple products can be supplied in a variety of forms.

Joint production takes place partly because content can be distributed without incurring the cost of actual production (in the case of visualization), or of transporting a physical object to a different location and risking it becoming damaged. it also can liberate the consumer of the cost of travelling to the heritage location and perhaps of placing them in a dangerous situation.

Change in Supply Brought by Different Aims of Production

Supply of digital heritage culture is informed by the institutional goals for production. management of heritage sites and collections revolves around the preservation, use and development of cultural heritage assets. it can be said that preservation relates to the minimization of value loss, 'use' to the exploitation of existent value, and 'development' to an increase in the value of the cultural heritage assets (Brokerhof, 2006).

Use of collections has been limited by exhibition space, preservation concerns, objects being exhibited elsewhere, objects being on loan, objects and sites being conserved (repaired), objects not being selected for exhibition or simply sites not being open to the public (e.g. tombs monuments).

According to Frey (2000), the opportunity cost of vaulted and inaccessible cultural heritage is higher since they do not produce any contemplative (use) value. exhibited objects on-site can range from 5–15 per cent of the total collection.²⁵ the potential accessibility of heritage collections and sites distributed digitally (via CD-roms, videos and particularly the internet) frees them from these constraints. increasing access to collections or to historical buildings and sites is, not surprisingly, one important reason to digitize.²⁶

Preservation, use and development of collections, as core activities, can come into conflict if, for instance, too much access is allowed to a site leading to damage and decay or a delicate object is guarded against the elements to such a degree that access becomes impossible. similarly, resources could be allocated to the acquisition of new pieces or to the research of an existing collection to such a degree that few resources are left to care for and preserve the collections. balancing the three activities informs resource allocation with the aim being to optimize the value of sites and collections.

Digitization can support all three activities. not all objects are created equal, however, and resources are not unlimited. allocating resources towards digitization is also determined by the multiple aims of production. institutions select objects to be digitized based on the available resources (e.g. time, space, knowledge) and anticipating the highest impact (e.g. protect fragile objects, increase access, increase sales, increase online visits).

This has lead to a number of exercises to estimate the cost of digitization and to identify cost reduction strategies (see tanner, 2006). cost factors include: (1) the nature, complexity and fragility of input (the material to be digitized, the digitization process and the information requirements); (2) the operational efficiency (and repeatability) of the management and production processes (knowledge required to increase efficiency and the availability of improved equipment); and (3) the quality, scope, complexity and durability of the output (the digital asset and related metadata) (Poole, 2010).

The characteristics of the object to be digitized include a set of cultural values. establishing these characteristics institutionally, or valuating the asset, may be informed further by categories such as collection value (an object being of value because it forms part of a collection), scientific or research value,²⁷ documentation value (e.g. maps), high attraction or exhibition value and rarity value.²⁸ each of these characteristics can provide the impetus for spearheading a digitization project.

The cost related to the quality of the image is marginal, so it is generally assumed a high-resolution image will be made as lower quality versions can subsequently be made at practically no cost. the opposite is not possible. However, the long-term costs related to storage and preservation have led to alternative production models. Heritage institutions have to choose between the advantages of high-resolution and large format imaging against the high storage costs this represents. mass digitization projects, or the making available of large quantities of heritage content, would favor lower quality imaging.²⁹ that is, digitization can increase the supply of digital cultural heritage (i.e. mass digitization) or the supply of high quality representations for selected (e.g. fragile) objects.

The Amsterdam city archives serve as an example. storage of large size digital files in mass quantity leads to prohibitive costs. With the goal of scanning 10 000 documents per week, most of them at customer's request paying a price comparable to an ordinary copy, a minimum quality stand- ard was identified to produce legible textual information.³⁰

Changes in Supply Brought by Expectations of Change in Future Consumption

Five major business models are worth exploring for pricing supply of digital cultural heritage. these are (1) selling online space to advertisers, (2) selling

physical products online, (3) digital commerce, (4) subscription- based environments and (5) online donor programmes.

Selling online space for advertisers (selling user attention) could be applied to digital heritage websites of large museums where banner- ads are sold for major sponsors. this is also referred to as a two-sided market³¹ where distributors recoup costs by charging for advertising space while content is made accessible free to the consumer. sale of physical products online may be relevant for large museums with an established brand that can draw online retail consumers. some institutions have explored e-ticketing to enter the heritage sites. digital commerce, or licensing the use of digital cultural heritage, has gained attention across sectors in the heritage field partially because of the legal cost of clearing reproduction rights. subscription-based environments are particularly popular for consumers specializing in quality products.³² lastly, online donor programmes are gaining popularity as a form of indirect price discrimination where the individual chooses how much to donate to the institution (without purchasing a product). recently, efforts to gather funds online by a crowd have been referred to as ‘crowdfunding’, where the distributor organizes the pooling of resources provided by individuals.³³

Supply of digital cultural heritage can increase or decrease based on estimated future consumer behavior. in principle, digital technologies allow for a ubiquitous distribution of heritage content and consumption is only limited by content distribution (online or on-site, in physical or digital format). measuring consumption of heritage can inform consumer behavior and can serve as an indication of future behavior in relation to a change in price. However, measuring consumption is still technically challenging and heritage institutions have developed ways to measure distribution in order to estimate consumption.

The internet enables the storing and analyzing of large quantities of data regarding consumer behavior and consumer preferences. Passive generation of content, or activity logs, has received much criticism for its inaccuracy in measuring online activity. However, there are great benefits in having large samples of quantitative data that can be tracked over time. data contains actual user behavior rather than activity reported or assumed, freeing bias from observer or questioner (Peacock, 2002).

Web statistics are gaining interest from heritage organizations as an inexpensive source of information about consumers. the internet proto- col address (IP address) indicates location of the visitor, the web site of origin signals entry point (previous action, e.g. google, europeana), the search terms most used reflect interests, the most viewed pages illustrates relevance, length of visit point to engagement, and repeated visits denote some form of success (Voorbij, 2009). this information can be used to estimate changes in consumer behavior.

The use of web statistics raises a number of questions regarding online goods and services. new forms of distribution require new forms of performance indicators. for example, there appears to be a change in the way heritage institutions assess visitors: heritage institutions count the number of all visitors on-site while online the focus moves to counting unique visitors.³⁴ similarly, the duration and online activity towards goods and services is valued with a certain level of precision (i.e. duration of visit, number of pages viewed) while on-site activities are still broadly measured (entry to museum but not number of art works viewed or gallery rooms visited). still, analysis of consumer behavior can assist in web design, in content generation and presentation strategies as well as in changes in supply based on expected changes of consumption.³⁵

So far, there are few estimates on the degree to which collections are distributed online. in the Netherlands it is estimated that 52 per cent of heritage collections are available online in catalogue form and 41 per cent have a digital image.³⁶ Part of the difficulty lies in homogenizing terminology across sectors to define digitization, digital collections and digital activities, and in establishing a comparable unit of measure. there are no estimates on quantity distribution through multiple or mixed channels (i.e. digital images being distributed in the online catalogue and via Flickr).

demand for digital cultural Heritage

New services are being devised in an effort to increase demand and by repositioning heritage assets in an evolving digital market. demand for heritage content at any time from any location without reducing availability to others, is perhaps the core advantage brought to cultural heritage by digital technologies. demand can increase or decrease as a reaction to availability of substitute goods and of complementary goods, and in relation to the familiarity users may have with technology. most importantly, demand for digital cultural heritage increases with ‘use’.

Changes in Demand Brought by Available Substitute Goods

Consumers may choose to visit a museum based on geographic proximity and not on the quality of the collections. for the market, not all digital cultural heritage assets are created equal. consumption is related to selection of a good among other similar goods. consumers will favour products based on individual, immediate (changing) needs while institutions will prioritize allocation of resources to assets with a higher perceived value. ‘Value is, in other words, both various and variable’ (Throsby, 2001:28).

Culture has both an economic value related to the physical work exchanged in a goods market, and a cultural value that responds to the ideas being exchanged in a marketplace for ideas (Throsby, 2001; Hutter and Throsby, 2008). digital cultural heritage can thus be seen as an exchangeable idea in a market where abundance has replaced scarcity (Hutter, 2003). consumers rely on some form

of content selection, prioritization, or ordering when faced with the vast choice offered in the online market of the World Wide Web.

Information science theory contends that selection of information is based on perceived characteristics of reliability, validity, completeness, actuality, verifiability, correctness, integrity, relevance and access (Boekhorst, 2004). as cultural heritage is digitized and placed in a market of information, demand would then follow the same selection process.

Reliability is linked to provenance; it evaluates the source of the document, the reason for production, and the moment and place of production. Validity is closely linked to the quality of representation of the original; it defines the usefulness and comprehensiveness of the found information for the particular goal (i.e. a 3d scan would serve a different purpose than the 2d image though both can represent the same object). completeness, it can be argued, is no longer attainable because every event is a continuum and boundaries are more and more difficult to define, particularly on the internet. correctness refers to the process of production of information and is dependent on the choices made during aggregation and selection of information (i.e. during the digitization of a building). actuality refers to the moment in time represented by data and the moment when data was created (a good example is the consumption of stock market information priced by time of publication). Verifiability is associated with the ability to check the correctness, completeness and actuality of information. integrity of information relates to the ability to repeatedly access the same information (i.e. accessing the same document at the same url). relevance is linked to the degree to which the representation is able to evoke the original and depends on the purpose of production (e.g. a low-resolution image may be easier to read though a high-resolution image may reveal paper texture). lastly, access to information is highly valued when this is efficient and effective. that means, getting to the right information at the right moment (finding last week's agenda is of no use when planning a visit to the movies). accessing information is a skill that requires different abilities depending on the information system used.

Demand for digital cultural heritage, therefore, will increasingly respond to attaining the right information, in the right format, at the right place and time, or information characteristics of relevance, format, and accessibility. in other words, digitization transforms cultural heritage into a marketable asset³⁷ to be placed in a market of information.

Changes in Demand Brought by Changes in Complementary Goods

Cultural institutions hold unique collections, of generally unique objects. as content becomes digitized and placed online, it comes into competition with all other information available online. interestingly, in the case of cultural heritage information, its significance lies in the 'authoritative metadata describing an object and its context', more than from only the digital images

(Besser and Yamashita, 1998). this specialized and quality information is what sets cultural heritage apart from other information objects in the digital information market.³⁸ demand for digital cultural heritage can increase if content presents additional value (e.g. an image with context).

Online, abundance rules and filters support a form of prioritization of the content for consumption. consumers can increasingly personalize their supply of digital content (e.g. through social media). demand for digital cultural heritage is linked to findability. demand will increase if personalized filters can find the content. curiously, users can participate in facilitating access to collections by providing information that supports identification of collections.³⁹

The fear of losing physical visitors due to online content distribution has been contended in several accounts (see Peacock, 2002; Marty, 2008; Peereboom et al. 2010). data shows, however, that users visit online museums to inform on-site visits and content distribution increases awareness (and desire) to visit collections.⁴⁰ digital cultural heritage can be a complementary good to physical cultural heritage, so that demand in one would increase demand in the other.

The fear of losing sales when publishing free content online has also been contended and once again appears to be unfounded. knowing the content and location of collections has lead to an increase in object loan requests, signifying additional income for museums (Marty, 2008). one noticeable example is that the online publication of Van Gogh letters (full content made available for free) did not appear to compete with the sale of the paper book version (sold at €395 per piece) (Peereboom et al. 2010).

Demand for digital cultural heritage is therefore likely to increase when demand for physical cultural heritage increases. this is because digital and physical are complementary representations of the same cultural heritage.

Changes in Demand Brought by Changes in Technology Use

Demand for digital cultural heritage also responds to the digital literacy of consumers. in other words, it is expected that, as more people become familiar with the internet, mobile devices and digital media, demand for digital cultural heritage will increase.⁴¹

As previously mentioned, heritage workers were first to consume digital cultural heritage. Heritage institutions have been producers, consumers and often brokers 'mediating, filtering or packaging information from within the organization for external users' (Peacock, 2008:64). increasing technology literacy of the labour force will further increase demand for digital cultural heritage.

Unfortunately there has been little empirical research done in cultural economics that has taken advantage of digital logs to assess demand of digital

cultural heritage based on access to digital content. one study that looked at the supply and demand of online material focused on the consumer's process of selection and its knowledge of technology.⁴² this is because, as Mackenzie Owen (2007) argues, consumers 'decide what they wish to acquire and use, and through which channels' (p. 58) from content available in a *transaction space*. that is, consumers select and use based on their knowledge of the supply and of the distribution channels (largely influenced by technology literacy) in the market of information. it is ultimately the consumer 'who controls whether or not a transaction will be performed' (idem). the consumer is essential to the process of production (Peacock and Godfrey 1997).

It is not surprising therefore to find a demand preference for digital cultural heritage that follows first a valuation method aligned with the user's information skills and information needs. demand for digital cultural heritage is also expected to increase with the technical advancements in supply, as objects are produced following best practice (e.g. technical and metadata standards) and maximizing technology's potential (e.g. exploring mixed and layered distribution). Heritage institutions 'are challenged to acknowledge information sources beyond the [institution], and change their practices to incorporate new perspectives into both interpretation and documentation' (Trant, 2008: 275). demand for digital cultural heritage includes demand for information.

Changes in Demand Brought by Changes in Consumer Taste

Demand for cultural heritage presents a special dynamic in that users need to experience the good before being able to value it, so a positive past experience leads to an increase in demand, which in turn grows over time (seaman, 2006; Throsby, 2001; Shapiro and Varian, 1999). for example, a user that reads a book and finds it a positive experience would want to read more work of the same author. this choice can only be made after reading the first book. easy availability of the book would facilitate a first book encounter, which may lead to future demand. finding the book a positive experience depends on taste (and technology in the case of e-books).

Digital cultural heritage presents both information characteristics as well as cultural heritage characteristics. demand for information goods can increase with familiarity with the content and the medium. demand for cultural heritage can increase with individual preference for the object. this preference will be informed by what can be called aesthetics and sensations (McCain, 2003). digital technology is an important factor in the experience of demand, together with awareness of the content and user choice (Mackenzie Owen, 2007), which in turn is linked to taste.

It is no surprise to find a higher demand for well-known cultural heritage. knowing the story of Vincent van Gogh for example will increase appreciation and future demand for his work. discussing with others (e.g. in social networks) or learning from those in the know (e.g. friends) can further increase future

demand. this is because it is easier to trust what others seem to have valued.⁴³ demand for digital cultural heritage benefits from a rich digital social network.

That is, technology plays an important role in the user's experience because it can facilitate or hinder consumption. demand for digital cultural heritage is informed by past experiences, by personal choice and by the familiarity with the content and the medium. Most importantly digital technology can facilitate the reproduction and distribution of images and can assist information transfer to inform potential future consumers of digital cultural heritage, resulting in an increase in demand.

Conclusions

The adoption of digital technologies in society has brought a change in the supply and demand of cultural heritage. digital cultural heritage (both goods and services) has become an object in itself with two parts, representation (that can be a conversion or a surrogacy) and documentation (identification and contextualization). digital products can be made through a digitization process or can be born digital. this signifies a change in the production process that can accommodate for new objects (including layered and mixed media), new systems of production (assisted by consumers), and new forms of distribution (as information service).

Allocating significant up-front resources can be challenging as benefits result in access to content increasing over time. there is room for increasing the benefits brought by digitization in the supply of and demand for cultural heritage. new forms of cultural heritage representation are being explored to best respond to the changing social environment.

The main goal of supply remains increasing universal access to cultural heritage. digital technology allows for repositioning past production into a market of information, freeing cultural heritage from constraints of time and space, and facilitating new levels of analysis and access. due to the nature of digital cultural heritage, content can be non-rival (so the consumption by one person does not infringe further consumption). digitization represents a 'new renaissance' for objects (EC, 2011). new distribution channels and presentation contexts raise awareness of the information inherent in collections. the democratization of content through digital channels goes hand in hand with an expansion of the traditional roles of producers and consumers.

Egon Schiele said that art cannot be modern; art is eternal. Digitization would make universal and eternal access to heritage a reality.

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notes

1. the digital libraries initiative aims to enable access to european heritage (ec, 2006a).
2. unesco has partnered with the international center for the study of the Preservation and restoration of cultural Property (iccrom) to form re-org. the organization, formed in 2007, aims to increase knowledge of information and communications technology (ict)(by improving digital documentation systems, adoption of ict and use of the internet) focused on museums with lesser resources (www.re-org.org).
3. a heritage collection can be delimited by a physical or legal entity (i.e. the collection of a museum, the national collection, the francois Pinault collection) as well as by conceptual groupings based on themes or joint characteristics.
4. When intangible heritage is acquired by a heritage institution, these become 'objects' in the collection. as objects, they are preserved, researched, and exhibited – generally as tangible objects (i.e. tape recording of a story telling).
5. migration refers to the adaptation of digital formats into current platforms (such as from software version 1.1 to version 2.0). migration is a continual process and eventually results in a different digital asset. emulation, on the other hand, does not change the digital asset but adapts the environment into current platforms.
6. a surrogate is an object meant to replace an original. in digital form, surrogacy results from technical limitations in the conversion of objects. in fact, it is this inaccuracy of conversion that allows the creation of new forms of heritage.
7. larger museums have collaborated to develop digital collection management systems since the late 1960s to decrease duplication of registration activities, improve inventory of objects and access collection information remotely. agreements on collection registration standards have been coordinated internationally by the international council of museums international committee for documentation that established cidoc in 1950. since 1996, cidoc has worked on a conceptual reference model (crm) an ontology to 'facilitate the integration, mediation and interchange of heterogeneous cultural heritage information' (<http://cidoc.mediahost.org>).
8. since the 1980s, and driven by the adoption of computers, the international archival community has worked on harmonizing document description and document placing within a context. these efforts have led to the general international standard archival description (isad(g)) and the encoded archival description (ead).
9. archaeology produces data from site excavation (or aerial and geographic surveys) and from the analysis of such data.
10. in 2007, dutch museums also reported managing ict in house (50 per cent), outsourcing management partially (37 per cent) and totally (13 per cent) (nmV and den, 2008; Van de Voort, 1991).
11. lock-in costs can be substantial. one example involves the adoption of analogue videodisks to record images and information about the collections. the investment in the new technology was lost when 'digital imaging became affordable for museums, [and

analogue videodisk] was abandoned and, unfortunately, in most cases, the museums were not able to repurpose the images' (burton Jones, 2008:16).

12. Preparation of objects includes identifying the appropriate activity for each object in the collection, as not all objects can be submitted to all type of activities (e.g. digitization, preservation, 3d imaging, and so on). fragile objects or material requiring copy-right clearance may not be selected for digitization (Holtman, 2006).
13. acquisition and scanning can be machine assisted, as is the case of mass digitization projects. delicate objects do require manual handling.
14. largely manual activity.
15. management is partially automated, yet human intervention is required for regular quality checks.
16. interoperability refers to the way content is formatted which determines the ability to reuse information (i.e. create versioning and to repurpose produced goods into multiple services).
17. Processes of preservation can be made automated yet human intervention is of essence to ensure quality control.
18. the blue ribbon task force (2010) and the dutch national coalition for digital sustainability are two examples that intend to bring awareness of sustainability issues and to advocate for economic sustainability of investment in digital heritage. in europe, the digital Preservation e-uropa program supports a collaborative approach to advance research on preservation of heritage (<http://www.digitalpreservationeurope.eu>).
19. minimal preparation of objects prior to the digitization process may result in a poor quality image while a thorough process of standards-compliant cataloguing will guarantee the availability of contextual, legal, and technical information for later retrieval. thorough work during the initial stages can help avoid future additional labor costs related to data clean up.
20. for example, paintings can best be represented through a scan when small or a photograph when large. text content can be read from a scan but can best be accessed with optical character recognition (ocr) technology to allow searching content based on words. sculptures (and sites) benefit from a three-dimensional representation (e.g. google street view used to explore the roman colosseum) (<http://maps.google.com/help/maps/streetview/>).
21. this is not new for heritage institutions who have long since made versions of their content (e.g. a painting consumed in exhibit, for research, or as postcard).
22. for a list of heritage institutions (galleries, libraries, archives and museums) working with creative commons see <http://wiki.creativecommons.org/glam>.
23. a unique and successful example of the coordinated crowdsourcing input can be found outside of the heritage field in the website of 'stranded whales' managed by the ncb naturalis, the dutch center for biodiversity (<http://www.walvisstrandingen.nl>), where anybody can input data found about whales around the dutch coasts. this type of collaborative work has slowly emerged in cultural heritage institutions. examples include the amsterdam ethnographic museum tropenmuseum collaborating with Wikipedia commons where the public is invited to add images, to support the categorization process, to report errors, and to identify candidate images for restoration (<http://commons.wikimedia.org/wiki/commons:tropenmuseum>). in the archive world, the

amsterdam city archive is developing a nationwide platform where archive institutions provide content to be indexed by consumers called 'many Hands' (<http://mili-tieregisters.nl>). a unique example in the library world can be found at the australian newspaper Project, where consumers have corrected 12.5 million lines of text. the cost of doing the work by library staff is prohibitory (<http://www.nla.gov.au/ndp/>).

24. ar, or visualization of layered information, has been developed for hand-held navigation systems by mixing location-based content combining gPs (global Positioning system), orientation sensors, 3d graphics, live video and Web services through an interface. examples include the eu-funded project itacitus, intelligent tourism and cultural information through ubiquitous services (see <http://www.itacitus.org>). miralab from the university of geneva developed a methodology for real-time mobile mixed reality systems applied to Pompeii (Papagiannakis and magnenat-thalmann, 2007). Prototypes of visualization interfaces, including enkin (see <http://enkin.net>), are generally designed for an iPhone consumer.
25. a study conducted at the Prado museum in madrid in 1992 found that only 10 per cent of the collections were on display (frey, 2000). museums in the netherlands estimate a similar figure (see, for instance, Voorthuijsen, 2009) though actual data has yet to be published.
26. from a study conducted in the netherlands, access to present and future generations, for specialized and for general public, was considered the main reason to digitize. other reasons included the conservation and management of collections (den, 2009).
27. the netherlands organization for scientific research (nWo) has allocated €4 million for the odysee project. the project intends to gather raw archeological data of scientific and research value from projects that have taken place in the period between 1900 and 2000. a new law requires all archaeology activity to produce a report. odysee was created to give access to the unpublished archaeology activity. an online database, managed by the netherlands cultural Heritage agency (icn 2010), makes the data available for scientific consumption.
28. most countries have developed a ranking system to guide allocation of resources. the dutch ministry of culture used a valuation system to rank cultural heritage assets into a, b, c and d categories as part of the delta Plan for the Preservation of cultural Heritage of 1990. objects ranked as being a or b represented the irreplaceable and invaluable cultural heritage assets in the country. these objects presented a standardization value (used to mark a period or style), a link value (to bring cohesion in the collection) or a symbolic value (generally representing a historic event).
29. conditions to choose high or low quality imaging can be linked to the type of object: high costs related to storage of large files (of high quality) can easily be argued for top pieces, vulnerable materials or often used objects. resources allocated towards quality will be missed in quantity. When resources are channelled to achieve a larger production, a high quality per piece result becomes incompatible.
30. customers have the choice of requesting a photograph quality scan, with an average cost being ten times higher than an archive quality scan (Holtman, 2006).
31. a two-sided market is characteristic of media content which is distributed or broadcast through a platform (television, radio, newspaper, or magazine) where interaction of viewers and advertisers is mediated (anderson and gabszewicz, 2006). a dual market in the arts consists of 'a market for physical works and a market for ideas. the former determines the work's economic value and the latter its cultural value' (throsby, 2008: 79).

32. examples include the art museum image consortium amico, a non-profit database of selected images contributed by the 180 member institutions in use between 1997 and 2005 (www.amico.org); and artstore, a non-profit digital image library holding more than one million images contributed by its 1300 international members (www.artstore.org).
33. a recent example of crowdfunding can be found in the louvre pooling €1 200 000 from 7000 online donors to buy the “three graces” by lucas cranach the elder (<http://www.troisgraces.fr/en/#/campaign>).
34. traffic in a website can be estimated by counting the number of page views during a session, the number of sessions (or visits to the website), the visit duration, single page visits, unique visitors, new visitors, return visitors, or repeat visitors. report periods can last one week, one month or half a year. Web analytic software can combine user’s data to estimate i.e. depth of visit based on numbers of pages viewed per visitor (Voorbij, 2009).
35. a study on the use of Web statistics in heritage institutions in the netherlands found little knowledge on web statistics and lack of clarity on terminology, only 7 institutions analyse web statistics regularly (den, 2009). a revision of 112 yearly reports showed 66 per cent of institutions make mention of web statistics presenting numbers on a table with limited explanation (Voorbij, 2009).
36. this estimate comes from a 2008 survey of 128 heritage institutions, of which 38 were archives, 21 libraries, 49 museums and 11 combined institutions, in which respondents were asked about the production and costs of digitized collections (navarrete, 2009; navarrete and Huysmans, 2009).
37. information is an asset in itself and not a by-product of service production (trant, 2008; Zorich, 2008).
38. for example, viewing a city center through google maps street view allows identifying images of the area made by other users, supply of heritage institutions would presumably receive more attention. one example can be found in the images published in the social media site of flickr by the brooklyn museum (www.flickr.com/photos/brooklyn_museum/collections/) or by the dutch national archive (www.flickr.com/photos/nationaalarchief/4682092026/).
39. methods to find and access content are being developed to facilitate ease and speed. one method being developed makes use of user-generated content. networked resources can be tagged with descriptive words to identify and categorize collections using an alternative and supplemental perspective. examples include the steve museum Project (<http://steve.museum>), the new York Public library (<http://digitalgallery.nypl.org>) and the brooklyn museum (<http://www.brooklynmuseum.org/opencollection/collections>).
40. a public survey at the Van gogh museum showed that ‘many people look up information on the internet, use mobile media or participate in social networks before or after visiting the museum’ (Peereboom et al., 2010). log data from the national museum of australia website show visitors left the site after viewing ‘what’s on’, ‘feature exhibition’, ‘exhibitions’ and ‘visiting the museum’ web pages presumably planning an on-site visit to the museum (Peacock, 2002).
41. broadband internet access in european households (27 countries) has increased from 15 per cent in 2004 to 61 per cent in 2010. similarly, european individuals (27 countries) using a mobile phone to access the internet has increased from 1 per cent in 2006 to 7 per cent in 2010 (iceland, luxembourg and sweden ranking the highest with 23 per cent, 20 per cent and 20 per cent respectively). in 2010, more than 91 per cent of dutch youth reported being active in social media (such as Hyves, facebook and twitter). social media

is increasingly the preferred medium to exchange information among youth (ec, 2006b); epp.eurostat.ec.europa.eu; www.statsline.cbs.nl).

42. see mackenzie owen (2007). one example of consumer behaviour analysis based on logged search data can be found in the dutch national archive. information retrieval patterns, based on queries and use of archival finding aids, were used to identify *novice*- and an *expert*-type users (Zhang and kamps, 2010).
43. the case of superstars, as individuals or as museum exhibits, is born from this case of positive network externalities in which demand increases as response to knowledge about availability. demand can be extremely high, can become compulsory (e.g. during a tourist visit) and can represent an important source of income (frey, 2000; schulze, 2007).

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